Executive Summary

Final Report for Travel Time Data Collection Pilot Project

April 1999

Background

The Travel Time Data Collection Pilot Project was conducted to help MTC and the Partnership decide whether and how to pursue system-wide monitoring of travel time and the variability of travel time. Interest in these data evolved from work conducted for MTC by David Jones in 1995 that impressed the importance of measuring measure performance from the customer's perspective that is modally neutral and encompasses the entire system. The project sought to extend Jones' work by identifying, testing, and evaluating promising data collection methods for two customer oriented measures: 1) a convenient commute as measured by door-to-door travel time; and 2) system reliability as measured by variability of day-to-day travel times for selected links of the Metropolitan Transportation System (MTS). MTC envisioned this data could be presented in an annual or biennial "state of the system report" to better understand of customer experiences, track system performance over time, and identify potential deficiencies that may require further investigation.

State of the System Report

Though MTC has not yet developed specifications for a state of the system report, hypothetical specifications were proposed for the purposes of evaluation. The report might include:

- Door-to-door travel time and variability of travel time for representative origin-destination pairs and modes; for example Vallejo to San Francisco by auto, ferry, and train to illustrate customer experiences and trends for policy makers and the public.
- Various travel time and related statistics (speed, delay, travel time variability) by mode for individual corridors or system segments to track performance or identify potential deficiencies.
- Variability of trip times by time of day as measured by the 90^{th} and 10^{th} percentile.
- Summary statistics at the corridor, county or regional level to provide a broad picture.

Other Potential Data Applications

During the course of the project, the need to clarify and distinguish several applications for travel time and related data became increasingly apparent. The two applications most directly related to the state of the system report concept carried the most weight in this study's evaluation of data collection methods:

1. Public Information on Customer Perception (or Customer Satisfaction) – David Jones' vision for using door-to-door travel time as a customer oriented measure extrapolates most readily to this application.
2. Deficiency Identification – Data would be used to monitor changes in performance over time, flag potential problem areas, and prioritize planning efforts.

Though this study does not attempt to define data needs for other applications, it offers a preliminary evaluation of the ability of various data collection techniques to address the following:

3. Guiding Investment Decisions – Data would be used to prioritize projects for funding.

4. Real-time System Operations – Data would be used to identify and respond to incidents and congestion in real-time.
5. Real-time Traveler Information – Data would be disseminated to the traveling public to inform decisions on mode, route choice, and departure time.

Data Collection Techniques

The data collection techniques examined in the study can be grouped into large categories according to their method of sampling travel time.

1. Spot speed measurement techniques measure the instantaneous speeds of vehicles either at specific spots of the roadway or at specific times of the day. These techniques are very cost-effective at gathering large amounts of speed data for specific segments of the transportation system but cannot provide door-to-door travel times.
   - Roadside Sensors: Roadside sensors include in-the-road loop detectors, roadside radar, microwave sensors, video sensors, and infrared sensors. These location based sampling methods suffer from the biases inherent in measuring speeds at a point and assuming the speed is applicable to other points on the roadway.
   - Aerial Photography: Tests of aerial photography against floating cars have found speeds measured from photos can be reliably extrapolated to obtain point to point travel times. The costs of data reduction from the photos is the single greatest drawback to the use of aerial photography.
2. Vehicle tracing techniques involve tracking either test vehicles or randomly selected vehicles through to determine the travel times between pre-selected check points. They are good techniques for measuring trip segment travel times.
   - Test Vehicle (Floating Car) Technique: This common technique consists of hiring someone to drive a vehicle along a pre-selected route and measure the elapsed time and distance traversed. It is possible to equip the vehicles to automate measurement and recording.
   - Non-Instrumented Vehicle Tracking Technique: This technique identifies randomly selected vehicles at successive checkpoints. Variations include license plate matching with or without matching software, and loop detectors with vehicle signature matching.
   - Passive Probe Technique: This technique requires special instrumentation of vehicles and roadside monitoring stations. Variations include automatic vehicle location, automatic vehicle identification, emergency vehicle tracking, cellular phone geolocation, and global positioning satellite (GPS).
   - Transit Vehicle Tracking Techniques: The discussion under this category focuses on the special issues involved in working with public transit agencies to monitor public transit vehicles with schedules and on-time performance monitoring data.
   - Truck Tracking Techniques: Monitoring trucks requires the active cooperation of the vehicle fleet owner who must consent to the placement of any special devices in the vehicle, or must transcribe manual logs and share the information with interested public agencies. In most cases, travel time information must be manually

sorted out by the operator before it can be transmitted to a public agency, making the process labor intensive.

3. Trip maker tracing techniques survey travelers either after they have completed their trip or recruit volunteers in advance to record and report their travel times.
   - Retrospective Surveys: Retrospective surveys quiz the traveler about their trip travel times and experiences after the fact. Variations explored include household telephone surveys, surveys of employees at their work sites, and website/ e-mail surveys
   - Prospective Surveys: Prospective surveys involve at least two contacts with each individual: one contact to recruit the individual, and a second to collect the information. Travelers can be asked in advance to note a great deal of detail about their trips, including travel times for specific segments of the trip.
   - Utilizing Other Surveys: Public agencies currently survey at least 22,000 commuters in the Bay Area every couple of years. It would be possible to add limited questions on travel time to the largest of these surveys, for example the RIDES commute survey. MTC also conducts its own prospective survey of 10,000 households every 10 years to collect extensive data on travel habits and trips times.

Evaluation

The evaluation of the various methods drew upon both results obtained in field testing conducted during the course of the Pilot Project and existing research and literature. Field testing was performed in during the summer to explore techniques for which inadequate data was available in published literature. Tests included low cost techniques for distributing and collecting employer/employee surveys using public agency staff as volunteers. A web-based survey instrument with e-mail notification was tested along with a simple paper survey instrument. Transit agencies and private freight carriers were also contacted and interviewed to determine the methods they currently employ to monitor their system performance and the potential for sharing this information with MTC.
The evaluation criteria focus on the suitability of methods to collect data for the state of the system report envisioned by MTC. Criteria applied in the evaluation include:

- Coverage (modal, temporal/market, and geographic),
- Cost (capital and maintenance),
- Local experience and potential to coordinate with local agency efforts,
- Length of time necessary to implement,
- Sufficiency of data for customer perception and deficiency monitoring in support of a state of the system report; sufficiency considers data accuracy and the ability to collect door-to-door travel time and variability data. The sufficiency criterion also addresses these factors with respect to the other three applications for travel time and related data.

Summary of Findings

The study suggests a state of the system report could be supported by a combination of surveys and segment monitoring data collection techniques. Survey methods are well-suited to collect data on customer perception and, depending on the sampling rigor and structure, may provide more general planning data. The evaluation identifies a number of segment monitoring methods suitable for collecting data for a state of the system report but recommends deferring a final decision until the completion of the TravInfo™ data coverage plan. The most promising methods also have potential for real-time data applications, which could be used to justify the substantial infrastructure investments required.

After investigating a large number of data collection techniques, this study confirmed suspicions that there is no simple, inexpensive solution for collecting travel time data. Nonetheless, several conclusions can be drawn. (See **Error! Reference source not found.** for a summary)

- Survey methods are best suited to collect data on customer perception and can be implemented immediately. MTC currently conducts comprehensive prospective household travel surveys approximately every 5 years. While it would be prohibitively expensive to increase the frequency of these efforts, these efforts can serve as anchors or calibration points for less comprehensive surveys conducted more frequently. Surveys can also provide an opportunity to ask a range questions related to customer satisfaction with the transportation system. The biggest question, to be answered through discussions with MTC's partner agencies, is the appropriate level of sampling rigor, which will affect data quality and the ability to use the data for a variety of planning purposes. Options range from piggy-backing on the annual RIDES commute survey, which offers statistically significant data by county of residence, to surveying employees through their employers, which offers geographically targeted data with a potentially larger sample bias.

- Segment performance data collected for deficiency monitoring could compliment the survey data by focusing on specific facilities and corridors, which is costly to do with surveys. In addition, segment data can provide a reality check for perception data collected through survey efforts.

  The Pilot Project identifies five methods well-suited for segment monitoring on roadway facilities: floating cars, roadside sensors (spot speeds or extrapolation), passive probes (electronic toll collection (ETC) probes or areawide probes), digital aerial photography, and license plate matching with character recognition software. Except for floating cars and aerial photography, these methods require significant investment in data collection infrastructure and are potentially good for real-time data for operations and traveler information in addition to deficiency monitoring.

MTC should wait for the outcome of the recently initiated project to develop data coverage plan for TravInfo™, the region's real-time traveler information system, before settling on a data collection method for this element of the state of the system report. The TravInfo™ study, to be completed in summer 1999, will research the types of real-time information travelers seek and analyze existing and potential data sources.

- Both the surveys and the roadway segment monitoring methods can provide data on variability. For the time being, transit on-time performance data, variable among operators, is the best source of data on travel time variability for transit.

Additional conclusions relate to data collection for specific modes:

- Though the use of travel time data estimated from transit schedules is not a good method for deficiency identification, it would compliment data collected through survey efforts. As advanced vehicle location (AVL) systems come on line in the next 3-5 years, they may provide better segment travel time and variability data for transit; however, integrating data from a number of sources and in a number of formats could still be complicated.
- The best means to collect data applicable to the freight market is to ensure general data collection efforts on freeways and arterials cover heavy freight facilities during periods of peak freight movement. Despite a high level of willingness to cooperate among members of MTC's freight advisory council, it is prohibitively complicated and costly to survey the freight market for a regional state of the system report at this time.
- It is reasonable to rely on survey methods to provide data on bicycle travel.